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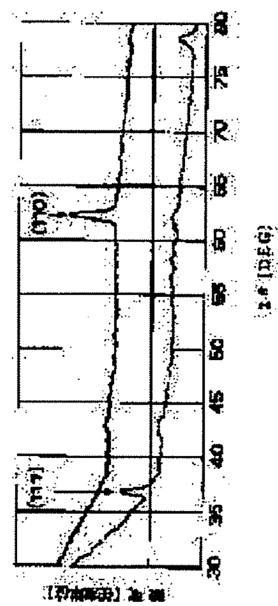
(54) PLASMA DISPLAY PANEL

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance sputtering resistance of a protective film by arranging a magnesium oxide film of a 110 orientation.
SOLUTION: An MgO film of a 110 orientation is formed as a protective film on a surface of a dielectric layer of PbO type low melting point glass of a plasma display panel. A glass substrate on which a sustained electrode and the dielectric layer are formed is fixed in an evaporation device chamber, and as one example, oxygen partial pressure is kept in 1 × 10-4Torr, and steam partial pressure is kept in a constant value, and evaporation is performed. Hydrogen gas and oxygen gas are introduced, and for example, the steam partial pressure is set in a range not more than 5 × 10-4Torr, and the 110 orientation is enhanced according to an increase in the steam partial pressure exceeding 1 × 10-4Torr. When the membrane of the MgO film formed into the dielectric layer is taken as 110 orientation, a membrane close to high density bulk is obtained, and sputtering resistance can be enhanced.



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CLAIMS

[Claim(s)]

[Claim 1] The plasma display panel characterized by coming to prepare the magnesium oxide film of orientation (110) as a surface protective coat of the dielectric layer which covers a display electrode.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the plasma display panel (PDP) of AC mold. In recent years, since PDP is suitable for the movie display from the liquid crystal device, it has come to be conjointly used widely for the application of a television image, the monitor of a computer, etc. with the color screen having been put in practical use. Moreover, it is observed as a big screen flat mold device for Hi-Vision. In such a situation, improvement in engine performance, such as reduction and reinforcement of high-definition-izing and power consumption, is advanced.
[0002]
[Description of the Prior Art] In the AC mold PDP, the electrode of the pair for discharge is covered with dielectric layers, such as low melting glass, and the heat-resistant protective coat for protecting from the ion bombardment at the time of discharge on the surface of a dielectric layer further is prepared. Since a protective coat touches discharge space, it has effect in a discharge property with the big quality of the material and membraneous quality. Generally, the magnesium oxide (MgO: magnesia) is used as a protective coat ingredient. MgO is a metallic oxide with a large secondary-electron-emission multiplier, by using this, breakdown voltage falls and a drive becomes easy-ization.
[0003] In MgO, some differences are in a secondary-electron-emission multiplier by crystal orientation. In the case of orientation (111), it is widely known for the measurement using the bulk (substrate) which started the single crystal ingot of MgO that a secondary-electron-emission multiplier is the largest. Then, in the conventional PDP, the MgO film of orientation (111) with a thickness of about 1 micrometer was formed on the surface of the dielectric layer by the vacuum deposition method. Vacuum deposition is excellent in respect of productivity and membraneous quality compared with other membrane formation technique (blasting of an organic-acid metal salt, spreading of impalpable powder, etc.).
[0004]
[Problem(s) to be Solved by the Invention] The life of 10000 hours is realized by covering a dielectric layer with the MgO film of orientation (111) with a thickness of about 1 micrometer as mentioned above. However, the longer one of a life is desirable. Moreover, if it is going to attain highly minute-ization, since an ion bombardment will increase with contraction of a discharging gap, advance of the spatter of the MgO film will speed up and a life will become short. If the MgO film can be shaved and a dielectric layer is exposed, breakdown voltage will rise sharply and will become drive impossible. If thickness is increased in order to prolong a life, it will become easy to generate a crack.
[0005] This invention raises the spatter-proof nature of the protective coat of a dielectric layer, and aims at attaining reinforcement.
[0006]
[Means for Solving the Problem] The orientation (110) film is [in / for a chief aim / not a secondary-electron-emission multiplier but spatter-proof nature] superior to the orientation (111) film. As for the field (110), in the crystal structure (Na-Cl mold) of MgO, a channeling tends to happen rather than a field (111). That is, incidence ion tends to go into the interior of a crystal deeply, and the spatter

near surface cannot happen easily. Moreover, it turned out that a consistency becomes the high membraneous quality near bulk, so that orientation (110) became remarkable rather than the case where it is orientation (111), when the membraneous quality of the MgO film which actually formed membranes on the dielectric layer was investigated. Spatter-proof nature is so high that it is precise.
[0007] It comes to prepare the MgO (magnesium oxide) film of orientation (110) as a surface protective coat of the dielectric layer with which PDP of invention of claim 1 covers a display electrode. Here, the MgO film of orientation (110) is film with which the orientation (110) crystal (a field parallel to a film flat surface is the crystal of {111} sides) became dominance on the number to other crystals, and it is formed of the high frequency ion plating in the inside of the ambient atmosphere of suitable oxygen tension and a steam partial pressure etc.
[0008]
[Embodiment of the Invention] Drawing 1 is the decomposition perspective view showing the internal structure of PDP1 concerning this invention. PDP1 of instantiation is the AC mold PDP of a field discharge format. The sustain electrodes X and Y of a pair are arranged for every Rhine of a matrix display by the inside of the glass substrate 11 by the side of a front face. Each consists of transparence electric conduction film 41 and a metal membrane 42, and, as for the sustain electrodes X and Y, is covered with the dielectric layer 17 whose thickness for AC drive is about 50 micrometers to discharge space 30. The ingredient of a dielectric layer 17 is PbO system low melting glass. The MgO film of the orientation whose thickness is about 1 micrometer as a protective coat 18 (110) is formed in the front face of a dielectric layer 17. On the other hand, the fluorescent substance layers 28R, 28G, and 28B of three colors for the address electrode A, a septum 29, and color display (R, G, B) are formed in the inside of the glass substrate 21 by the side of a tooth back. Discharge space 30 is divided for every subpixel EU in the direction of Rhine by the septum 29, and the gap dimension of discharge space 30 is specified to constant value. Neon is filled up with penin GUGASU which mixed the xenon of a minute amount in discharge space 30.
[0009] It consists of three subpixel EU of a display to which 1 pixel (pixel) of EG(s) is located in a line in the direction of Rhine. Since the arrangement pattern of a septum 29 is a stripe pattern, the part corresponding to each train of the discharge space 30 is continuing in the direction of a train ranging over all Rhine. The luminescent color of the subpixel EU within each train is the same. In PDP1, the address electrode A and the sustain electrode Y are used for selection (addressing) of lighting (luminescence) / astigmatism LGT of Subpixel EU. That is, a screen scan is performed to Rhine sequential and a predetermined electrification condition is formed of discharge between the sustain electrode Y and the address electrode A chosen according to the contents of a display. After addressing, if the sustain pulse of predetermined peak value is impressed to the sustain electrode Y and the sustain electrode X by turns, the field discharge along a substrate side will arise in the cel in which it is at the addressing termination time and the wall charge of the specified quantity existed. The fluorescent substance layers 28R, 28G, and 28B are locally excited by the ultraviolet rays generated in field discharge, and light is emitted. The light which emits light in the fluorescent substance layers 28R, 28G, and 28B, and penetrates a glass substrate 11 turns into display light.
[0010] Drawing 2 is drawing showing orientation distribution of a protective coat. In PDP1, the orientation (110) film excellent in spatter-proof nature is prepared in

the advantageous MgO film on low-voltage-izing of breakdown voltage as a protective coat 18 of a dielectric layer 17 as mentioned above. The continuous line in drawing 2 shows the result of analysis by the X-ray diffractometer to a protective coat 18, and the chain line shows the result of analysis of the conventional example. In the protective coat 18 of this operation gestalt, when 2theta (angle of diffraction) is about 63 degrees, a peak remarkable in diffraction reinforcement is seen, and it turns out that a protective coat 18 is orientation (110) film so that clearly from drawing.

[0011] PDP1 of the above structure is manufactured through the process which prepares a predetermined component separately about each glass substrates 11 and 21, the process which carries out opposite arrangement of the glass substrates 11 and 21, and closes a perimeter, the process which encloses discharge gas. A protective coat 18 is formed at a glass substrate 11 side by the vacuum deposition (the high frequency ion plating method) which generates the plasma for example, within a chamber in that case. Hereafter, the example of the formation approach of a protective coat 18 is explained.

[0012]

[Example] Vacuum evaporationo equipment equipped with the evaporation source of an electron-beam-heating mold and the 13.56MHz RF generator is used. The glass substrate 11 in which the sustain electrodes X and Y and a dielectric layer 17 were formed is fixed in a chamber.

[0013] After exhausting until it reached degree of vacuum 7x10-7Torr, oxygen tension was maintained at 1x10-4Torr, and it vapor-deposited by maintaining a steam partial pressure at the constant value of 1x10-5 - 1x10-3Torr within the limits. A setup of a steam partial pressure was performed by introducing hydrogen gas and oxygen gas. Substrate temperature was made into 250 degrees C, and high-frequency power was set to 1kW.

[0014] Drawing 3 is a graph which shows the relation between a steam partial pressure and the crystal stacking tendency of the MgO film. The axis of ordinate of drawing 3 shows the magnitude of the reinforcement (peak intensity) of the diffracted light of each crystal orientation in an X diffraction.

[0015] In 5x10 to 4 or less Torrs, a stacking tendency increases as a steam partial pressure increases (110). If 1x10-4Torr is exceeded especially, a stacking tendency (111) will fall rapidly and a stacking tendency will increase rapidly conversely (110). In 5x10-4Torr, it becomes the nearly perfect (110) orientation film. If a steam partial pressure exceeds 5x10-4Torr, the plasma will stop occurring by the fall of a degree of vacuum, and a crystal will stop being able to grow up easily. In addition, also when oxygen tension was set to 3x10-4Torr, the stacking tendency (110) increased with the increment in a steam partial pressure. (110) In order to obtain the orientation film, it is desirable to set a steam partial pressure or more [of oxygen tension] to 1/2 within limits to which total pressure does not exceed an upper limit.

[0016] Next, evaluation of spatter-proof nature is explained. Only the steam partial pressure was changed among membrane formation conditions, MgO was vapor-deposited to the piece of soda lime glass of 2cm angle which ground the front face, and two or more samples from which a stacking tendency differs were produced. Ion etching (source gas: Ar, acceleration voltage:200V) was performed to the MgO film which covered some MgO film of each sample with the mask, and exposed it. And the level difference of an etching part and a masking part was measured by

the thickness gage (precision of **100A). The result is shown in Table 1. The reinforcement (peak intensity) in Table 1 is the value of standard which set reinforcement of the orientation (110) of a sample 6 to 100. In addition, although the piece of soda lime glass was used as a substrate in order to secure the surface smoothness of a membrane formation side, as a substrate of membrane formation, it is almost same between a dielectric layer (low melting glass) and soda lime glass.

[0017]

[Table 1]

試料番号	水蒸気分圧 [Torr]	(111)の強度 [規格値]	(110)の強度 [規格値]	スパッタ量 [Å]
0	0 (従来例)	50	0	1000
1	1×10^{-5}	50	0	980
2	2×10^{-5}	48	0	950
3	5×10^{-5}	53	4	940
4	1×10^{-4}	55	11	980
5	2×10^{-4}	50	60	690
6	5×10^{-4}	0	100	480
7	1×10^{-3}	0	45	760

[0018] (110) It turns out that the amount of spatters (etching depth) is excellent in spatter-proof nature few, so that orientation is remarkable. In an above-mentioned operation gestalt, although PDP1 of a field discharge mold was illustrated, this invention is applicable also to PDP of an opposite discharge mold. The formation approach of the MgO film of the orientation (110) as a protective coat 18 is not limited to the approach of instantiation.

[0019]

[Effect of the Invention] According to invention of claim 1, the spatter-proof nature of the protective coat of a dielectric layer can be raised, and reinforcement can be attained.